URBAN AIR MONITORING PROGRAM

1983

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SYNOPSIS

This report summarizes the urban air quality data collected in Saskatchewan during the period January to December, 1983. The cities of Regina, Saskatoon, Moose Jaw, Lloydminster and Estevan are monitored under the National Air Pollution Surveillance (NAPS) Program developed by Environment Canada in conjunction with the provinces. The purpose of the program is to obtain information and trend data on the levels of air pollution in cities across Canada. Monitoring carried out in the remaining cities in the province was carried out under the Provincial Urban Air Monitoring Program.

Fifteen high volume air samplers were used in 1983 to collect data on suspended particulate levels in Saskatchewan. Analysis of the results indicates that particulate levels are decreasing. The provincial standard of 70 micrograms per cubic metre (12 month geometric mean) was not exceeded in 1983.

Sulphur dioxide levels in the commercial areas of the major cities are very low. The provincial one hour ambient standard of 17 parts per hundred million (450 micrograms per cubic metre) was not exceeded in 1983.

In Saskatoon, the provincial one hour standard for carbon monoxide, 13 parts per million (15 milligrams per cubic metre) was exceeded once and the eight hour standard, 5 parts per million (6 milligrams per cubic metre) was exceeded on 10 occasions. In Regina, the one hour standard was exceeded twice and the eight hour standard was exceeded 18 times.

Ozone data collected in Regina in 1983 indicate the one hour standard of 5 parts per hundred million (100 micrograms per cubic metre) was exceeded 149 times. The 24 hour average standard of 1.5 parts per hundred million (30 micrograms per cubic metre) was exceeded at least once on 70 per cent of the days for which data is available. In Saskatoon the one hour standard was not exceeded and the 24 hour standard was exceeded at least once on 41 per cent of the days for which data is available. High ozone levels can occur in both rural and forested areas; it is believed that background concentrations may be making some contributions to the levels observed.

In Regina and Saskatoon the one hour nitrogen dioxide standard of 20 parts per hundred million (400 micrograms per cubic metre) as well as the 24 hour standard, 10 parts per hundred million (200 micrograms per cubic metre) were not exceeded during the year.

An annual air quality index was calculated for Regina based upon the available data. The index transforms the measured concentrations of air pollutants into a single number and descriptive term that represent both the measured and publicly perceived quality of the ambient air. The 1983 index was calculated to be 29 which is described as fair.

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1. INTRODUCTION

Continuous ambient air pollution monitoring in the urban areas of Saskatchewan began in 1970. Since that time a permanent network of monitoring stations has been established which provides a good geographic coverage of the more highly populated and industrialized areas of the province. These stations are located in commercial and/or residential areas in five centres, Regina, Saskatoon, Moose Jaw, Lloydminster and Estevan. Additional ambient monitoring equipment is available and used for specific short-term projects, industrial surveillance and complaint investigations.

This report summarizes the data obtained in the urban areas of the province during the period January to December, 1983.

2. NATIONAL AIR POLLUTION SURVEILLANCE PROGRAM

The National Air Pollution Surveillance (NAPS) Program was developed to obtain information on the levels of air pollution in the urban areas of Canada. This program is a joint project operated by the federal and provincial levels of government. Environment Canada supplies the required equipment as well as assistance with installation and maintenance. The Air Pollution Control Branch of Saskatchewn Environment conducts routine equipment maintenance and calibration, in addition to collection of the raw monitoring data. The results are typically published in provincial reports such as this one, but are also sent to Ottawa for additional processing and national publication. Well over 500 sampling instruments are operated in 51 cities across Canada, under the NAPS Program.

A knowledge of the nature and extent of air pollution in Canadian cities is vital to the planning of control programs. Therefore, the major objective of the NAPS Program is to continuously measure the concentrations of the major air pollutants in urban centres in order to evaluate the success of existing and establish the need for additional air pollution control activities.

The reader is reminded that the data presented in this report is specific to the locations of the sampling instruments. It would be incorrect to assume that the concentrations reported are representative of the levels to be found in rural areas or

industrial parks, for example. Monitoring locations within the cities were generally chosen in accordance with criteria established by Environment Canada; areas with excessively high or low levels of air pollution have been avoided. The Air Pollution Control Branch and various industries conduct additional ambient monitoring apart from the NAPS Program and the data is available upon request.

3. SASKATCHEWAN URBAN AIR MONITORING NETWORK

Table 1 illustrates the network of air pollution monitors which are currently in operation as well as those which were operated in 1983. As can be seen from the table, some major changes have been made in order to consolidate and improve the network. Two additional instruments were installed in Saskatoon with the result that the Regina and Saskatoon stations are identical with respect to the pollutants monitored. A sulphur dioxide monitor was also added in Estevan.

The other major change to the network was the removal of high volume samplers from Prince Albert, Swift Current, North Battleford, Yorkton, Weyburn and Melville. It was decided that a good suspended particulate monitoring data base has been collected, however, this does not give an adequate picture of air quality in these cities and more extensive monitoring is required. Beginning with Moose Jaw, air pollution monitoring in the smaller cities will be carried out on a rotational basis using both suspended particulate and gaseous monitors. Every six months the equipment will be moved to another city so that approximately once in four years every centre will be monitored. In this way data will be obtained on all of the major air pollutants and this information will be more useful to the program than the data previously collected.

Table 1

SASKATCHEWAN URBAN AIR MONITORING NETWORK

	Existing	Previous
Regina	3 High-Volume Samplers 1 Sulphur Dioxide Monitor 1 Carbon Monoxide Monitor 1 Oxides of Nitrogen Monitor 1 Ozone Monitor	3 High Volume Samplers 1 Sulphur Dioxide Monitor 1 Carbon Monoxide Monitor 1 Oxides of Nitrogen Monitor 1 Ozone Monitor
Saskatoon	2 High-Volume Samplers 1 Sulphur Dioxide Monitor 1 Carbon Monoxide Monitor 1 Oxides of Nitrogen Monitor 1 Ozone Monitor	2 High-Volume Samplers 1 Sulphur Dioxide Monitor 1 Carbon Monoxide Monitor
Lloydminster	1 High-Volume Sampler 1 Sulphur Dioxide Monitor	1 High-Volume Sampler 1 Sulphur Dioxide Monitor
Estevan	1 High-Volume Sampler 1 Sulphur Dioxide Monitor	1 High-Volume Sampler
Moose Jaw*	1 High-Volume Sampler 1 Sulphur Dioxide Monitor 1 Carbon Monoxide Monitor 1 Oxides of Nitrogen Monitor 1 Ozone Monitor 1 Hydrogen Sulphide Monitor	1 High-Volume Sampler 1 Sulphur Dioxide Monitor
Prince Albert* Swift Current* North Battleford* Yorkton* Weyburn* Melville* Melfort*	 1 High-Volume Sampler	1 High-Volume Sampler 1 Sulphur Dioxide Monitor 1 High-Volume Sampler 1 High-Volume Sampler 1 High-Volume Sampler 1 High-Volume Sampler 1 High-Volume Sampler 1 High-Volume Sampler
* Air monitoring at these centres will be carried out on a rotational basis.		

4. OPERATION OF MONITORS

4.1 High Volume Air Sampler

The high volume air sampler consists of a suction motor, timer mechanism and circular chart recorder, all enclosed in an aluminum housing measuring approximately 45 cm x 45 cm x 135 cm. A large volume of air is drawn through a preweighed filter over a period of 24 hours at a flow rate of approximately 20 litres per second. After the sample if collected, the filter is removed and weighed to determine the amount of particulate matter deposited. Total suspended particulates are measured in micrograms per cubic metre of air (ug/m^3). All high volume air samplers in the province are operated on the same sampling schedule, once every six days as set out in the NAPS Program.

4.2 Sulphur Dioxide Monitors

Two different types of sulphur dioxide monitors are used in the program. One uses coulometric titration and the other uses ultraviolet fluorescence as the detection method.

In the first method an ambient air sample is continuously bubbled into an aqueous solution containing sulfuric acid and potassium bromide. Sulphur dioxide in the sample disturbs an oxidation - reduction equilibrium in the solution and this is detected by an indicator electrode. An electrical current, which is proportional to the sulphur

dioxide concentration in the air, is used to regenerate the solution equilibrium.

In the ultraviolet fluorescence method the ambient sample is drawn into a reaction cell where it comes into contact with an ultraviolet light beam. Sulphur dioxide molecules in the sample are excited by the UV light and they fluoresce. A photomultiplier tube is used to measure the light given off by the sulphur dioxide molecules and the output from the tube is used to determine the pollutant concentration.

Concentrations of sulphur dioxide are reported in parts per hundred million by volume (pphm).

4.3 Carbon Monoxide Monitor

Carbon monoxide is measured continuously by non-dispersive infrared spectrometry. An air sample passes at a controlled rate through an air pump, a filter to remove moisture and particulates and into the analyser. Subsequent analysis is carried out by comparing the infrared energy absorbed by the air sample to that absorbed by a reference cell. The difference in energy is converted electro-mechanically into a carbon monoxide concentration. Carbon monoxide levels are reported in parts per million by volume (ppm).

4.4 Ozone Monitors

Two different types of ozone monitors are used; one based on chemiluminescence and the other based on ultraviolet absorption.

In the chemiluminescent method ambient air is drawn into a reaction chamber in which a reaction occurs between ethylene and any ozone in the sample. This reaction produces light which is detected by a photomultiplier tube. The concentration of ozone in the sample is determined from the output of the photomultiplier tube.

In the second method ambient air is drawn into a chamber and exposed to ultraviolet light. Ozone which is present in the sample will absorb some of the UV light and the resulting change in light intensity is used to determine the pollutant concentration. Ozone levels are reported in parts per hundred million by volume (pphm).

4.5 Nitrogen Dioxide Monitor

The chemiluminescent reaction of nitrogen oxide and ozone provides the basis for the measurement of nitrogen dioxide. The concentration of nitrogen oxide is measured directly by a photo electric cell which detects the amount of light produced through a reaction with ozone in a flow reactor. Total oxides of nitrogen (i.e. nitrogen oxide

plus nitrogen dioxide) is measured by passing the sample through a device which converts all nitrogen dioxide present into nitrogen oxide. The monitor alternately measures and internally stores these two concentrations. The nitrogen dioxide concentration is obtained by calculating the difference between total oxide and monoxide concentrations. Nitrogen dioxide concentrations are reported in parts per hundred million by volume (pphm).

5. RESULTS

5.1 Suspended Particulates

The suspended particulate concentrations obtained during 1983 are presented in Appendix A. The majority of sampling locations are classified as commercial, however, there are also residential ones which are useful for comparison. In general, the figures indicate that winter particulate levels are lower than those at other times of the year and residential concentrations are lower than commercial ones.

The annual geometric means, as shown in Table 2, indicate that suspended particulate levels in most areas declined in comparison to 1981 and 1982 results.

5.2 Sulphur Dioxide

The sulphur dioxide monitoring results are summarized in Tables 3 through 8. These tables indicate that the sulphur dioxide levels in the commercial areas of the major cities are very low. All annual arithmetic means recorded in 1983 are 0.0 pphm.

The maximum hourly sulphur dioxide concentrations recorded over the past 10 years are shown in Table 9. In the absence of major SO_2 sources near the monitoring stations, the maximums are well below the provincial standard of 17 pphm (450 ug/m^3).

Table 2

SUSPENDED PARTICULATES
ANNUAL GEOMETRIC MEANS
(Micrograms per cubic metre, ug/m^3)

City	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Regina (C) 1620 Albert					48	57	64	66	47	42
Regina (C)	66	65	57	55	47	48	63	62	48	40*
Regina (R)	43	39	36	38	29	31	41	38	31	26
Saskatoon (C)						73	69	63	53	36
Saskatoon (R)	50	55	63	57	53	58	57	50	47	41
Moose Jaw (C)	69	74	74	65	53	60	62	70	56	51
Prince Albert (C)	77	67	73	72	69	*	65	77	48	40*
Estevan (R)	53	63	59	55	48	55	49	40	40	39
Swift Current (C)	86	80	64	49	59	67	90	83	81	68*
North Battleford (C)	70	72	66	*	52	57	68	46	54	50*
Yorkton (C)	71	65	51	41	42	58	44	51	57	41*
Weyburn (C)	65	52	59	60	37	*	77	60	54	33*
Lloydminster (C)			57	*	57	54	*	*	62	46
Melville (R)			33	32	25	34	26	34	36	18**
Melfort (C)								*	50	41

Provincial Suspended Particulate Standards

- 24 hour average - 120 ug/m^3
- annual geometric mean - 70 ug/m^3

* - mean based on approximately six months of data (January to June)

**- mean based on approximately four months of data (January to April)

Table 3

CITY OF REGINA

SUMMARY OF SULPHUR DIOXIDE LEVELS, pphm
1983

Month	Maximum Hourly Average	Maximum Daily Average	Monthly Average
January	**	**	**
February	0.0	0.0	*
March	1.8	0.1	0.0
April	0.0	0.0	0.0
May	1.1	0.1	0.0
June	3.5	0.3	0.0
July	3.8	0.2	0.0
August	6.1	0.5	0.0
September	3.6	0.4	0.0
October	0.8	0.1	0.0
November	2.3	0.3	0.0
December	1.2	0.2	0.0

Provincial Sulphur Dioxide Standards
- 1 hour average - 17.0 pphm (450 ug/m^3)
- 24 hour average - 6.0 pphm (150 ug/m^3)
- annual average - 1.0 pphm (30 ug/m^3)

* Insufficient data to calculate monthly average.
** No data obtained for this month due to monitor malfunction.

Table 4

CITY OF SASKATOON

SUMMARY OF SULPHUR DIOXIDE LEVELS, pphm
1983

Month	Maximum Hourly Average	Maximum Daily Average	Monthly Average
January	0.0	0.0	0.0
February	0.0	0.0	0.0
March	0.0	0.0	0.0
April	0.0	0.0	0.0
May	0.0	0.0	*
June	0.0	0.0	0.0
July	0.0	0.0	0.0
August	0.0	0.0	*
September	0.0	0.0	0.0
October	0.3	0.0	0.0
November	0.0	0.0	0.0
December	0.0	0.0	0.0

Provincial Sulphur Dioxide Standards
- 1 hour average - 17.0 pphm (450 ug/m^3)
- 24 hour average - 6.0 pphm (150 ug/m^3)
- annual average - 1.0 pphm (30 ug/m^3)

* Insufficient data to calculate monthly average.

Table 5

CITY OF MOOSE JAW

SUMMARY OF SULPHUR DIOXIDE LEVELS, pphm
1983

Month	Maximum Hourly Average	Maximum Daily Average	Monthly Average
January	0.5	0.0	0.0
February	0.2	0.0	0.0
March	0.4	0.0	0.0
April	0.4	0.0	0.0
May	0.4	0.0	0.0
June	0.0	0.0	*
July			
August			
September			
October			
November			
December			

Provincial Sulphur Dioxide Standards
- 1 hour average - 17.0 pphm (450 ug/m^3)
- 24 hour average - 6.0 pphm (150 ug/m^3)
- annual average - 1.0 pphm (30 ug/m^3)

* Insufficient data to calculate monthly average.

NOTE: Monitoring for SO_2 discontinued at this site on June 6, 1983

Table 6

CITY OF PRINCE ALBERT

SUMMARY OF SULPHUR DIOXIDE LEVELS, pphm
1983

Month	Maximum Hourly Average	Maximum Daily Average	Monthly Average
January	1.1	0.1	0.0
February	0.4	0.0	0.0
March	0.5	0.0	0.0
April	0.5	0.0	0.0
May	0.9	0.1	0.0
June	0.4	0.0	0.0
July	0.4	0.0	0.0
August			
September			
October			
November			
December			

Provincial Sulphur Dioxide Standards
- 1 hour average - 17.0 pphm (450 ug/m^3)
- 24 hour average - 6.0 pphm (150 ug/m^3)
- annual average - 1.0 pphm (30 ug/m^3)

NOTE: Monitoring for SO_2 discontinued at this site on July 20/83

Table 7

CITY OF LLOYDMINSTER

SUMMARY OF SULPHUR DIOXIDE LEVELS, pphm
1983

Month	Maximum Hourly Average	Maximum Daily Average	Monthly Average
January	0.4	0.0	0.0
February	0.0	0.0	0.0
March	0.0	0.0	0.0
April	0.0	0.0	0.0
May	0.0	0.0	0.0
June	0.5	0.0	0.0
July	0.2	0.0	0.0
August	0.2	0.0	0.0
September	1.0	0.1	0.0
October	0.3	0.0	0.0
November	0.8	0.1	0.0
December	0.6	0.0	0.0

Provincial Sulphur Dioxide Standards
- 1 hour average - 17.0 pphm (450 ug/m^3)
- 24 hour average - 6.0 pphm (150 ug/m^3)
- annual average - 1.0 pphm (30 ug/m^3)

Table 8

CITY OF ESTEVAN

SUMMARY OF SULPHUR DIOXIDE LEVELS, pphm
1983

Month	Maximum Hourly Average	Maximum Daily Average	Monthly Average
January			
February			
March			
April			
May			
June			
July	2.3	0.4	*
August	1.0	0.1	0.0
September	1.1	0.3	0.0
October	1.3	0.2	0.0
November	0.3	0.0	0.0
December	0.0	0.0	*

Provincial Sulphur Dioxide Standards
- 1 hour average - 17.0 pphm (450 ug/m^3)
- 24 hour average - 6.0 pphm (150 ug/m^3)
- annual average - 1.0 pphm (30 ug/m^3)

* Insufficient data to calculate monthly average.

NOTE: Monitoring for SO_2 began at this site on July 29/83.

Table 9

SUMMARY OF SULPHUR DIOXIDE LEVELS
MAXIMUM HOURLY CONCENTRATIONS, pphm

City	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Regina	5.0	1.0	0.0	7.0	1.0	1.5	26.8	0.8	2.7	6.1
Saskatoon	3.0	8.0	17.0	6.0	5.4	5.8	0.5	0.5	2.3	0.3
Moose Jaw	6.0	15.0	5.0	5.0	4.9	0.9	2.2	2.0	0.5	0.5
Prince Albert		3.0	4.0	4.0	1.0	0.9	1.8	1.9	1.3	1.1
Lloydminster									2.9	1.0
Estevan										2.3

5.3 Carbon Monoxide

Summaries of the carbon monoxide data obtained during the year are found in Tables 10 and 11. Saskatoon results showed one and 10 exceedences of the one hour and 24 hour standards, respectively. The one hour standard was exceeded twice and the 24 hour standard was exceeded on 18 occasions at the Regina station.

5.4 Ozone

Ozone monitoring results for Regina and Saskatoon are summarized in Tables 12 and 13, respectively. In Saskatoon the one hour standard was not exceeded and the 24 hour standard was exceeded at least once on 83 days or 41 per cent of the sampling time. In Regina the one hour standard was exceeded 149 times and the 24 hour standard was exceeded at least once on 181 days or 70 per cent of the sampling time.

Table 10

CITY OF REGINA

SUMMARY OF CARBON MONOXIDE LEVELS, ppm
1983

Month	Maximum 1 Hour Average	Maximum 8 Hour Average	Maximum 24 Hour Average	Monthly Average
January	8.2	5.0	2.3	0.7
February	8.7	3.3	1.9	0.9
March	5.0	3.5	1.8	0.7
April	5.3	3.0	1.4	0.6
May	7.5	2.2	1.0	*
June	2.7	1.8	1.0	0.5
July	6.2	2.5	1.4	0.5
August	12.9	5.2	4.2	0.9
September	9.0	6.2	4.5	0.9
October	22.4	8.8	3.8	1.0
November	5.8	4.9	3.2	0.8
December	5.9	3.9	2.3	0.7

Provincial Carbon Monoxide Standards
- 1 hour average - 13 ppm (15 mg/m^3)
- 8 hour average - 5 ppm (6 mg/m^3)

* Insufficient data to calculate monthly average.

Table 11

CITY OF SASKATOON

SUMMARY OF CARBON MONOXIDE LEVELS, ppm
1983

Month	Maximum 1 Hour Average	Maximum 8 Hour Average	Maximum 24 Hour Average	Monthly Average
January	5.9	3.6	2.4	0.6
February	6.0	2.1	1.2	0.5
March	5.0	2.0	1.0	0.4
April	**	**	**	**
May	**	**	**	**
June	3.3	1.7	0.8	0.2
July	5.0	2.9	1.5	0.3
August	6.9	3.4	1.3	0.3
September	5.1	2.1	1.0	0.5
October	14.5	8.6	3.2	0.6
November	3.8	1.9	1.1	0.4
December	8.2	3.6	2.0	0.6

Provincial Carbon Monoxide Standards
- 1 hour average - 13 ppm (15 mg/m^3)
- 8 hour average - 5 ppm (6 mg/m^3)

** No data obtained for this month due to monitor malfunction.

Table 12

CITY OF REGINA

SUMMARY OF OZONE LEVELS, pphm
1983

Month	Maximum Hourly Average	Maximum Daily Average	Monthly Average
January	3.5	2.3	1.6
February	3.8	2.8	1.8
March	5.0	4.0	2.7
April	5.0	3.5	*
May	5.6	4.0	2.7
June	4.8	3.8	*
July	**	**	**
August	6.1	3.9	*
September	29.2	6.2	1.6
October	6.3	3.4	2.1
November	13.6	3.6	1.6
December	19.0	3.9	2.1

Provincial Ozone Standards
- 1 hour average - 5.0 pphm (100 mg/m^3)
- 24 hour average - 1.5 pphm (30 mg/m^3)

* Insufficient data to calculate monthly average.
** No data obtained for this month due to monitor malfunction.

Table 13

CITY OF SASKATOON

SUMMARY OF OZONE LEVELS, pphm
1983

Month	Maximum Hourly Average	Maximum Daily Average	Monthly Average
January			
February	2.7	2.2	*
March	2.9	2.2	1.4
April	4.2	2.8	1.5
May	4.0	2.4	1.8
June	4.0	2.9	1.6
July	3.5	2.3	*
August	**	**	**
September	**	**	**
October	2.5	1.4	*
November	2.9	1.9	1.1
December	2.7	2.3	1.3

Provincial Ozone Standards
- 1 hour average - 5.0 pphm (100 mg/m^3)
- 24 hour average - 1.5 pphm (30 mg/m^3)

* Insufficient data to calculate monthly mean.
** No data obtained for this month due to monitor malfunction.

NOTE: Monitoring for ozone began at this site on February 16/83

5.5 Nitrogen Dioxide

Tables 14 and 15 summarize the nitrogen dioxide data collected during 1983 in Regina and Saskatoon, respectively. The one hour and the 24 hour standards were not exceeded at either monitoring location during the year.

5.6 Annual Air Quality Index - Regina

The Federal-Provincial Committee on Air Pollution published a guideline for an annual air quality index in August, 1980*. The index transforms the measured concentrations of air pollutants into a single number and descriptive term that represent both the measured and the publicly perceived quality of the ambient air for a given time period and location. It is based upon the measured concentrations of the major pollutants which are not exceeded more than two per cent of the time.

Table 16 gives the applicable concentrations obtained during 1983 monitoring and the sub-indicies which resulted according to the guideline. The overall index is calculated by averaging the three highest sub-indicies and as indicated in the table, these are suspended

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* Guidelines for an Annual Air Quality Index, a Report by the Federal-Provincial Committee on Air Pollution, August, 1980, Cat. No. EN41-22/1980, ISBNO-662-50863-7.

Table 14

CITY OF REGINA

SUMMARY OF NITROGEN DIOXIDE LEVELS, pphm
1983

Month	Maximum 1 Hour Average	Maximum Daily Average	Monthly Average
January	5.2	2.5	0.8
February	12.4	4.9	1.8
March	10.2	5.8	2.2
April	5.5	3.8	*
May	5.9	3.4	*
June	**	**	**
July	2.5	1.4	*
August	6.0	3.1	1.4
September	9.1	4.0	1.6
October	8.1	3.1	1.6
November	6.4	3.7	*
December	10.6	8.1	*

Provincial Nitrogen Dioxide Standards
- 1 hour average - 20 pphm (400 ug/m^3)
- 24 hour average - 10 pphm (200 ug/m^3)

* Insufficient data to calculate monthly mean.
** No data obtained for this month due to monitor malfunction.

Table 15

CITY OF SASKATOON

SUMMARY OF NITROGEN DIOXIDE LEVELS, pphm
1983

Month	Maximum 1 Hour Average	Maximum Daily Average	Monthly Average
January			
February			
March			
April			
May	2.3	1.6	0.5
June	**	**	**
July	3.0	1.8	0.8
August	3.8	2.0	1.2
September	2.0	1.1	*
October	1.4	0.9	*
November	4.5	3.1	*
December	7.4	4.9	2.0

Provincial Nitrogen Dioxide Standards
- 1 hour average - 20 pphm (400 ug/m^3)
- 24 hour average - 10 pphm (200 ug/m^3)

* Insufficient data to calculate monthly mean.
** No data obtained for this month due to monitor malfunction.

NOTE: Monitoring for nitrogen dioxide began at this site on May 3/83.

Table 16

ANNUAL AIR QUALITY SUB-INDICIES
REGINA - 1983

Pollutant	98th Percentile Concentration	Sub-Index
suspended particulates	117 ug/m^3	46
ozone (1 hour)	5.2 pphm	26
carbon monoxide (8 hour)	3.1 ppm	15
carbon monoxide (1 hour)	4.6 ppm	8
sulphur dioxide (1 hour)	0.1 pphm	0
sulphur dioxide (24 hour)	0.0 pphm	0
nitrogen dioxide (24 hour)	insufficient data	
nitrogen dioxide (1 hour)	insufficient data	

particulates, ozone and carbon monoxide (8 hour). Using the values from the table, the annual index for Regina during 1983 was calculated to be 29 which means that the air quality at the sampling location can be described as fair. Table 17 is taken from the Federal-Provincial guideline and shows the scale which is used to obtain a verbal description of the index.

Table 18 summarizes the annual sub-indicies and overall indicies obtained during the past four years.

Table 17

VERBAL DESCRIPTOR SCALE FOR ANNUAL
AIR QUALITY INDICIES

Descriptor	Numerical Values of Overall Index
Good	0-25
Fair	26-50
Poor	51-100
Very Poor	Over 100

Table 18

ANNUAL AIR QUALITY SUB-INDICIES
REGINA - 1980 to 1983

Pollutant	Sub Index 1980	Sub Index 1981	Sub Index 1982	Sub Index 1983
suspended particulates	97	93	58	46
ozone (1 hour	28	32	22	26
carbon monoxide (8 hour)	12	27	19	15
carbon monoxide (1 hour)	7	13	4	8
sulphur dioxide (1 hour)	0	0	*	0
sulphur dioxide (24 hour)	0	0	*	0
nitrogen dioxide (24 hour)	*	**	**	*
nitrogen dioxide (1 hour)	*	**	**	*

Overall Index 1980 - 46 (fair)
Overall Index 1981 - 51 (poor)
Overall Index 1982 - 33 (fair)
Overall Index 1983 - 29 (fair)
* Insufficient data
** Insufficient reliable data

6. DISCUSSION OF RESULTS

High volume air monitoring results indicate a significant variation in suspended particulate concentrations between cities; the annual geometric means range from a low of 26 ug/m^3 in a residential area of Regina to a high of 68 ug/m^3 in Swift Current. Many factors influence the levels obtained and give rise to the variation, including the season, weather conditions vehicle traffic, construction, rural activity and monitor location. Particulate concentrations generally decreased during 1983 in comparison to the previous year's results.

Table 19 presents a summary of the suspended particulate monitoring data obtained over the past 14 years. The standard deviations associated with the annual means for each city indicate a significant variation in the results from year to year. This is to be expected with the large number of variables that can influence the annual averages. A linear regression analysis was performed on the data from each sampling location for which five or more years of monitoring has occurred. Twelve of the locations have a negatively sloped line as the best fit of the data and one has a positive slope. A negative slope indicates an overall trend towards lower average concentrations of suspended particulates, whereas, a positive slope indicates the opposite. Primarily because of the results obtained during the past two years, this analysis suggests that suspended particulate levels in the urban areas are decreasing.

Table 19

PROVINCIAL SUSPENDED PARTICULATE TRENDS

Sampling Location	Average Annual Geometric Mean Concentration ug/m^3	Years of Data	Standard Deviation of Annual Geometric Mean Concentrations ug/m^3	Slope of a Straight Line Fit Through Annual Mean Data ug/m^3/year
Regina (C) 1620 Albert	54	6	9.8	-1.7
Regina (C)	56	14	8.3	-1.0
Regina (R)	35	14	6.5	-0.6
Saskatoon (C)	59	5	14.8	-9.0
Saskatoon (R)	52	13	6.3	0.0
Moose Jaw (C)	62	12	8.8	-0.5
Prince Albert (C)	65	11	12.5	-1.3
Estevan (R)	51	12	8.2	-1.7
Swift Current (C)	73	10	13.3	0.4
North Battleford (C)	59	9	9.7	-2.4
Yorkton (C)	52	10	10.5	-1.8
Weyburn (C)	55	9	13.5	-1.2
Melville (R)	30	8	6.2	-0.8
Lloydminster (C)	55	5	5.9	-0.7

Sulphur dioxide levels continue to be very low. No violations of provincial standards were recorded during 1983 and all annual average concentrations were 0.0 pphm.

Carbon monoxide concentrations were generally below provincial standards and somewhat lower than last year's results. In Regina

and Saskatoon the number of one hour and twenty-four hour exceedences decreased in comparison to the 1982 values.

Transportation sources are the largest contributors of carbon monoxide to the urban atmosphere. One confirmation of this is the lower daily average concentrations which are measured on Sundays when automobile traffic in the downtown areas is at a minimum. The highest daily and monthly average concentrations measured during 1983 were in the fall and winter months when cold temperatures and stable conditions limited the dispersion of automobile and other exhausts. Although in excess of provincial standards, the highest concentrations were well below the levels at which widespread health effects or deterioration of human performance is experienced.

Ozone monitoring data indicate somewhat higher levels in 1983 compared to the previous year. In Regina, the provincial one hour standard was exceeded 149 times as opposed to 64 times in 1982. The number of days during which at least one twenty-four hour violation was recorded remained essentially unchanged (181 in 1983 compared to 195 in 1982). Based on the first year of monitoring in both major cities, Saskatoon ozone results appear to be significantly lower than those for Regina. The highest monthly ozone concentrations generally occur from March to August; during this period strong sunlight increases the occurrence of photochemical reactions between hydrocarbons and nitrogen dioxides

with the result that ozone is formed as a secondary pollutant. Summaries prepared by Environment Canada on the NAPS monitoring program show that the levels measured in Regina are typical of the concentrations found in western cities such as Calgary and Edmonton, and lower than Winnipeg, Windsor and Toronto, for example.

The ozone standard adopted by the province was initially established as a long-term goal for all parts of the country as one of the National Air Quality Objectives. The standard is being regularly exceeded in many areas of the country as a result of appreciable background levels and fluctuations in the baseline values due to weather conditions. The objectives for ozone are under review by the Federal-Provincial Committee on Air Pollution.

The amount of nitrogen dioxide monitoring data collected in Regina was reduced due to equipment malfunction. In Saskatoon, monitoring for the pollutant began in May and significant downtime was also experienced. The limited results that were obtained, however, indicate that nitrogen dioxide levels are well below provincial standards.

The annual air quality index for Regina in 1983 is 29 (fair). This value was calculated using the sub-indicies and 98th percentile concentrations given in Table 16. The index is useful for reducing a large volume of complex air monitoring data for

several contaminants to a single number on a scale which gives an overall impression of air quality. The index is a severe one as outlined in the following paragraph quoted from the explanatory guideline on the index:

> "Certain assumptions and value judgements are inherent in the index, perhaps the most important being the use of 98th percentile concentrations. This is recommended by the World Health Organization and means, for example, that if an annual index number of 29 (fair) were reported, the air quality during that year would have been better than or equal to 29 for 98 per cent of the time. It does not mean that the <u>average</u> air quality was 29. The remaining (or worst) 2 per cent usually reflects anomalies such as weather, industrial accidents, errors in the data, and fires near the monitoring stations. The index is thus "severe"."

The overall air quality index for 1981 was 51 (poor) and for 1982 it was 33 (fair). The 1983 result, therefore, represents a continuation of the trend to lower indicies that began the previous year. The major factor contributing to the lower averages is the suspended particulate sub-index. The amount of particulate matter in the atmosphere and hence the value of the sub-index is influenced to a large degree by precipitation levels. During the early part of 1982 and 1983, normal or even above normal rainfall was recorded in many areas. As a result,

the suspended particulate sub-indicies in 1982 and 1983 were substantially lower than the corresponding numbers for the previous two years. This is an excellent illustration of the influence that weather conditions can have on air pollution levels. Other factors, such as industrial emissions, fuel usage, traffic patterns, monitor locations, monitor operating schedule and monitor maintenance can also have a significant impact on the levels observed.

Additional air monitors have been added to the Saskatoon station and an annual index will also be calculated for that city for 1984. It will be useful to compare the results for Regina and Saskatoon so that any trends that may occur can be more easily determined and confirmed.

Suspended particulate results for all centres are contained in Appendix A. Data summaries for other pollutants are available upon request from either the Air Pollution Control Branch or Environment Canada.

APPENDIX A

SUSPENDED PARTICULATE MATTER RESULTS

Regina Station - 80109C (ugm/m^3/24 hours)
80102R (ugm/m^3/24 hours) 1983

SUSPENDED PARTICULATES

JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
6	18	17	5	21	14	1	28	20	6	239	38	6	98	43	5	70	42
12	24	12	11	20	15	7	9	10	12	117	56	12	28	-	11	64	54
18	29	19	17	59	16	13	19	12	18	69	27	18	59	30	17	66	41
24	15	13	23	48	15	19	112	31	24	114	43	24	72	33	23	70	43
30	11	6				25	45	19	30	67	39	30	73	35	29	91	52
						31	31	9									

JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
5	53	35	4	108	54	3	47	52	3	48	16	2	41	14	2	23	15
11	32	50	10	98	19	9	31	15	9	36	19	8	59	22	8	30	21
17	26	16	16	89	124	15	85	23	15	42	23	14	14	10	14	16	15
23	55	32	22	68	59	21	33	24	21	72	42	20	11	13	20	17	20
29	78	51	28	96	86	27	68	57	27	59	47	26	11	59	26	10	12

Regina Station 80108C - (ugm/m^3/24 hours) 1983

SUSPENDED PARTICULATES

JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
6	28		5	16		1	22		6	197		6	86		5	57	
12	22		11	17		7	15		12	109		12	48		11	-	
18	28		17	26		13	18		18	71		18	58		17	66	
24	20		23	28		19	110		24	91		24	52		23	58	
30	9					25	33		30	62		30	59		29	75	
						31	22										

JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R

Saskatoon - Station 80209C (ugm/m^3/24 hours)
Station 80203R (ugm/m^3/24 hours) 1983

SUSPENDED PARTICULATES

JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
6	35	33	5	21	25	1	-	-	6	85	79	6	-	54	5	-	54
12	44	52	11	35	-	7	-	-	12	65	-	12	-	55	11	-	55
18	76	87	17	33	-	13	-	17	18	86	67	18	-	47	17	74	85
24	25	20	23	23	-	19	-	75	24	-	-	24	-	119	23	-	-
30	8	10				25	-	47	30	-	-	30	-	71	29	-	-
						31	97	65									

JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
5	51	-	4	86	74	3	36	51	3	44	43	2	38	-	2	15	16
11	38	41	10	79	67	9	-	29	9	57	57	8	21	27	8	49	21
17	27	24	16	-	61	15	41	-	15	28	19	14	4	-	14	42	45
23	43	55	22	86	107	21	42	67	21	19	25	20	11	24	20	26	14
29	38	37	28	70	65	27	63	51	27	69	41	26	14	21	26	15	13

Moose Jaw - (ugm/m^3/24 hours) Commercial Location 1983

SUSPENDED PARTICULATES

JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
6	40		5	15		1	18		6	141		6	66		5	-	
12	48		11	23		7	12		12	72		12	46		11	68	
18	33		17	44		13	24		18	97		18	720		17	-	
24	14		23	34		19	-		24	113		24	524		23	-	
30	17					25	52		30	84		30	225		29	96	
						31	29										

JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
5	83		4	119		3	59		3	56		2	42		2	23	
11	43		10	74		9	39		9	-		8	45		8	36	
17	41		16	115		15	50		15	-		14	30		14	22	
23	60		22	64		21	-		21	124		20	14		20	28	
29	78		28	74		27	-		27	83		26	18		26	-	

Lloydminster - (ug/m^3/24 hours) Commercial Location 1983

SUSPENDED PARTICULATES

JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
6	17		5	12		1	10		6	101		6	75		5	-	
12	20		11	13		7	17		12	72		12	128		11	-	
18	23		17	40		13	23		18	227		18	341		17	145	
24	20		23	22		19	73		24	161		24	103		23	150	
30	13					25	160		30	80		30	111		29	-	
						31	46										

JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
5	-		4			3	123		3	99		2	22		2	14	
11	-		10			9	193		9	127		8	14		8	16	
17	-		16	110		15	155		15	31		14	14		14	29	
23	-		22	61		21	79		21	-		20	8		20	19	
29	-		28	86		27	68		27	62		26	21		26	11	

Estevan - (ugm/m^3/24 hours) Residential Location 1983

SUSPENDED PARTICULATES

JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
6		13	5		31	1		14	6		151	6		152	5		36
12		14	11		43	7		-	12		39	12		12	11		51
18		62.	17		18	13		21	18		105	18		32	17		66
24		17	23		-	19		95	24		75	24		38	23		99
30		30				25		51	30		87	30		-	29		89
						31		14									

JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
5		38	4		-	3		38	3		17	2		-	2		76
11		41	10		98	9		16	9		30	8		24	8		45
17		39	16		141	15		15	15		63	14		12	14		56
23		47	22		40	21		33	21		46	20		-	20		24
29		-	28		109	27		95	27		64	26		18	26		16

Prince Albert - (ugm/m^3/24 hours) Commercial Location 1983

SUSPENDED PARTICULATES

JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
6	14		5	31		1	16		6	86		6	79		5	52	
12	25		11	24		7	8		12	24		12	103		11	76	
18	43		17	23		13	17		18	61		18	55		17	123	
24	10		23	15		19	102		24	102		24	75		23	72	
30	6					26	69		30	74		30	160		29	-	
						31	27										

JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
5	54																
11	49																
17	45																

Melfort - (ugm/m^3/24 hours) Commercial Location 1983

SUSPENDED PARTICULATES

JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
6	-		5	15		1	15		6	67		6	59		5	71	
12	-		11	16		7	9		12	-		12	64		11	89	
18	-		17	24		13	14		18	-		18	82		17	130	
24	16		23	20		19	56		24	-		24	114		23	48	
30	9					25	20		30	65		30	87		29	96	
						31	27										

JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
5	36		4	100		3	33		3	-		2	24		2	16	
11	36		10	125		9	21		9	-		8	33		8	13	
17	61		16	70		15	83		15	60		14	12		14	20	
23	91		22	105		21	70		21	130		20	-		20	14	
29	55		28	66		27	154		27	-		26	-		26	-	

Melville - (ugm/m^3/24 hours) Residential Location 1983

SUSPENDED PARTICULATES

JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
6		-	5		11	1		12	6		161						
12		18	11		15	7		7	12		59						
18		25	17		-	13		12	18		32						
24		7	23		10	19		21	24		60						
30		8				25		15	30		-						
						31		11									

JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R

North Battleford - (ugm/m^3/24 hours) Commercial Location 1983

SUSPENDED PARTICULATES

JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
6	26		5	11		1	15		6	135		6	99		5	72	
12	31		11	21		7	9		12	93		12	101		11	112	
18	-		17	48		13	19		18	119		18	109		17	112	
24	19		23	25		19	-		24	74		24	66		23	72	
30	14					25	-		30	139		30	97		29	69	
						31	72										

JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
5	65																

Swift Current - (ugm/m^3/24 hours) Commercial Location 1983

SUSPENDED PARTICULATES

JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
6	44		5	19		1	25		6	118		6	163		5	79	
12	-		11	35		7	-		12	167		12	89		11	109	
18	25		17	28		13	-		18	80		18	112		17	-	
24	17		23	77		19	-		24	130		24	97		23	137	
30	12					25	176		30	44		30	66		29	116	
						31	158										

JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
5	131																
11	80																
17	80																
23	69																

Weyburn - (ugm/m^3/24 hours) Commercial Location 1983

SUSPENDED PARTICULATES

JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
6	26		5	11		1	29		6	191		6	59		5	35	
12	14		11	23		7	11		12	64		12	27		11	56	
18	25		17	25		13	13		18	72		18	37		17	62	
24	8		23	14		19	61		24	69		24	44		23	65	
30	10					25	45		30	46		30	42		29	76	
						31	11										

JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
5	65																
11	53																
17	38																

Yorkton - (ugm/m^3/24 hours) Commercial Location 1983

SUSPENDED PARTICULATES

JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
6	9		5	18		1	18		6	203		6	60		5	93	
12	23		11	18		7	-		12	-		12	27		11	38	
18	20		17	16		13	-		18	93		18	73		17	97	
24	10		23	17		19	-		24	110		24	97		23	82	
30	13					25	-		30	-		30	91		29	104	
						31	-										

JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER		
DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R	DATE	C	R
5	80																

APPENDIX B

LOCATION OF MONITORING STATIONS

LOCATION OF AMBIENT AIR MONITORS

City	Location
Regina (C)	Revenue Building, Smith Street
Regina (C)	Federal Building, 1620 Albert Street
Regina (R)	Provincial Lab, Wascana Centre
Saskatoon (C)	Kelsey Institute, Idlywyld Drive
Saskatoon (R)	Porteous Lodge, 833 Avenue P
Moose Jaw (C)	Sask Tel Building, Fairford Street
Prince Albert (C)	Provincial Building, 1257 1st Avenue East
Estevan (R)	St. Joseph's Hospital
Swift Current (C)	Swift Current Locker Plant, 137 1st Avenue N.W.
North Battleford (C)	Post Office
Yorkton (C)	Provincial Building, 72 Smith Street East
Weyburn (C)	Fire Hall
Lloydminster (C)	Old RCMP Building, 44th Street & 48th Avenue
Melville (R)	St. Henry School, Main Street
Melfort (C)	Provincial Building, 105 Crawford Street East

APPENDIX C

MONITORING EQUIPMENT INSTALLED

MONITORING INSTRUMENTS USED IN THE SASKATCHEWAN

URBAN AIR MONITORING PROGRAM

Air Pollutant	Instrument Manufacturer	Model Number
Sulfur Dioxide	Philips Monitor Labs	9700 8850
Carbon Monoxide	Bendix	8501
Nitrogen Dioxide	Thermo-Electron	14B
Ozone	Bendix Dasibi	8002 1003-PC
Suspended Particulates	General Metal Works Misco Scientific Sierra Instruments	GMWL 2000H 680 IH 2000 HCM